

CHAPTER 8

THE SANDFLY—DENGUE FEVER GROUP

CHIEF among the short-term fevers of military importance are sandfly fever and dengue fever. Other more or less clearly differentiated epidemic infections may be grouped with these, sharing the same diagnostic difficulties, for they can be recognised only by the collective patterns of their symptoms, by their epidemiology and the presence of appropriate vectors, when these are known.

Sandfly and dengue fevers show many close resemblances, though there are some distinctive clinical features in each in addition to the difference in vectors.

1. SANDFLY FEVER

Experiences of the last war indicated that the disease would cause wastage of men for short periods, but the first epidemic in 1940 was more extensive than expected. This was due to the fact that the troops were in fixed training camps in which considerable constructional work was carried out, thus providing the vector sandflies with abundant breeding places. During the period from May to November 1940, 946 patients (15 per cent of the total admissions) were admitted to the 2/1st Australian General Hospital with sandfly fever, many others contracted the infection while in hospital, and many hundreds were held in the 2/1st Australian C.C.S. or in camp hospitals. In 1941, 5,717 men with sandfly fever were admitted to hospital and 1,306 in 1942. Thus there must have been at least 9,000 or 10,000 men treated for the disease in the Middle East, and to these figures must be added the unknown cohorts of those who kept on their feet or recovered after some period off duty in their units.

SYMPTOMS

The symptoms showed the variability characteristic of this group: the clinical picture seen even in different camps over the same period did not always correspond closely. The onset was frequently sudden with minor shivering or followed a prodromal period of twenty-four to forty-eight hours. During this period there were headache, pains in back and limbs and striking malaise with feelings of heaviness and fatigue. The appearance of patients with the established disease was often striking, the face being red, puffy and swollen, and the eyes engorged owing to conjunctival congestion. Pain in the ocular muscles often limited the eye movements and photophobia was troublesome. In some epidemics a crop of clear vesicles was seen on the back part of the soft palate. It was noted that this enanthem also appeared in the early stages of infective hepatitis, the early symptoms of which often resembled sandfly fever; perhaps this explained the claim of some observers that jaundice occurred occasionally in sandfly fever. In Cyprus, for example, jaundice was described in patients believed

to have sandfly fever. No catarrhal signs in the respiratory tract were found as a rule, but in some outbreaks in which such signs appeared it was not clear whether they were due to a pre-existing infection or to the disease. No rashes were described in most epidemics, but a faint macular rash was observed in a few instances in 1940, though in 1941-1942 in Syria as high a proportion as 10-15 per cent of patients were reported as showing sparse pink macules on the trunk. This rash was seen on the first or second day. A faint mottling of the protected skin was also noted sometimes during the early days of convalescence. In some series this appeared in some 40 per cent of patients. A few petechiae were sometimes found, chiefly about the lower limbs.

The fever usually warranted the name of "three day fever", but longer bouts were not infrequent, and secondary rises were sometimes seen. A relative bradycardia was almost the rule, and a slow pulse was often noticed also during convalescence when a rate of 50 was not uncommon. Swelling of lymph glands was not observed in some outbreaks, but in later epidemics it sometimes occurred. Splenic enlargement was unusual, but did occur apart from other infections. Anorexia was striking, and nausea and vomiting sometimes occurred. Occasional diarrhoea was noted for which no other bacteriological cause was found. Drowsiness was extremely common, though restlessness at night was equally common. True meningeal irritation was probably uncommon, but resistance in the tender neck muscles sometimes gave that impression. In one series neck stiffness was reported in some 10 per cent of cases, though the cells in the cerebro-spinal fluid did not exceed 10 per millilitre. In another series increase of pressure in the cerebro-spinal fluid was found where neck rigidity was present, but increase in cells was only slight. The skin was often hyper-aesthetic on the trunk, and a feeling of constriction round the lower part of the chest was common, sometimes suggesting the Bornholm disease. The blood often showed a slight neutropenia. Giddiness was an occasional complaint during early convalescence. Labyrinthine disturbances were seen in a few instances, but their aetiology was not clear. Convalescence was often slowed by lethargy and depression, and on the average some eight to ten days elapsed after the onset before a man was approximately fit. Reinfection or recrudescence of the original infection was sometimes seen within a period of a few weeks, but some long range immunity was gained, for many of those affected in one year seemed to be substantially protected during the next. In one A.I.F. hospital a considerable proportion of patients had a relapse or reinfection in periods ranging from a week to three months. No sequels were observed. Diagnosis was not difficult once an epidemic began, but there was the usual tendency to attribute most fevers to a prevalent epidemic. Both malaria and relapsing fever have been confused with sandfly fever on occasion.

EPIDEMIOLOGY

It was not found possible to carry out some researches which had been planned by pathological staffs in 1940 or 1941 in Palestine. However,

certain epidemiological observations were made. There was no doubt concerning the constant relation between the vector and the disease. The siting of a string of semi-permanent military camps in an endemic area provided hundreds of excavations and masses of rough rubble where breeding could take place, and countless places where the adult flies could harbour during the day. Yet, so inconspicuous are these minute hairy flies that most of the people bitten by them had never recognised them. A search in dark sheltered places usually revealed them with their curiously hovering and restricted flight. It was noticeable how certain hospital wards harboured infection, and some surgical wards, for example, once seeded with infected flies produced steady crops of the disease among their patients. On occasion outbreaks of short-term fevers were observed in Palestine and Syria whose identity was in doubt. Whether these were dengue or sandfly fever or some other variant was questioned. The absence of suitable mosquito vectors, especially in Palestine, made dengue unlikely. Further, the failure to find sandflies, except by one experienced in such surveys, was not conclusive, though it is admitted that as a rule plenty of vectors are necessary for the spread of insect-borne diseases. In Mersa Matruh, for example, it was stated that sandfly fever was present but without sandflies. This was surely due to the difficulty in finding the tiny vectors in dark dugouts. The same argument was used on occasion in Tobruk also, and is referred to elsewhere. The argument that symptoms are not "typical" is most insecure in the sandfly-dengue group, where the mutability of symptoms and the occurrence of mild cases with little disturbance other than a slight transitory fever are well recognised.

The later work of Sabin, Philip and Paul, of U.S.A., on sandfly fever showed by transmission experiments on volunteers that only demonstration of immunity and passage of experimental infection can clear up some of the problems of epidemics.

There were apparent inconsistencies in the characters of epidemics of sandfly fever as seen in Palestine and Syria, particularly in the Damascus and Tripoli areas, but these may be explained as epidemic variations, or possibly as evidence of different strains or mutations of the virus. In 1941 a short-term fever occurred in Sarafand in Palestine, in which a rash and glandular enlargement were common, and which resembled both sandfly and dengue fevers. Occasionally symptoms suggesting encephalomyelitis were seen. Without strong reasons it is, however, better not to subdivide classifications of infectious diseases which have similar clinical and epidemiological patterns.

The question of the occurrence of sandfly fever in Australia or New Guinea has been raised. In Australia no *papataci* varieties of the *Phlebotomus* are known, and, though comprehensive entomological surveys of all areas have not been made, there is no proof that sandfly fever exists in Australia. The same holds for New Guinea. It has been stated that sandflies were found in part of the Milne Bay area, and that they were abundant on some beaches between Salamaua and Lae. In the latter areas a short-term fever affected a considerable number of men. However,

no species of *Phlebotomus* which bites man has been found in these areas. It was established that the Salamaua-Lae outbreak was not malaria, and though its nature was not determined, no proved vector of insect-borne disease was discovered. The "sandflies" were found by entomologists to be of the *Culicoides* family, blood-suckers, but not known to transmit disease.

PREVENTION

Preventive measures against sandfly fever were not attempted on any wide scale in the Middle East. The breeding grounds of the sandflies were extensive, and neither material for effective sprays nor the means of applying them were readily available. Even the irritation of sandfly bites did not seem to goad sufferers into attacking the pest seriously. Repellent creams then available were greasy, uncomfortable and ineffective. Even had a good preparation been obtainable in 1940 no repellents were on issue in non-malarial areas, where most of the attacks occurred during that year. Mosquito nets did not adequately exclude sandflies and sandfly nets were not then available. The use of modern repellents and insecticides should alter the whole position of prophylaxis.

2. DENGUE FEVER

There had been extensive experience of dengue fever before the war in civilian communities in Australia. The disease had made its presence felt under three guises, that of the endemic form in northern areas such as Darwin, Thursday Island and Broome, the epidemic form in areas annually visited by the infection as it spread over the southward routes, where it was modified by a degree of protection in the community, and the epidemic form in areas visited only in exceptional years when it spread over communities virtually unprotected. In the first form it may be classed as chiefly a nuisance to newcomers. It has been suggested in some tropical areas that infection in native children may keep the virus active. The second form allows the disease much more scope, but it does not attain the role of a disrupter of a community as it has in areas usually untouched by its epidemic waves. In a mobile population like an army it may be of great importance and can contribute materially to the wastage of men and increase the strain on medical units.

SYMPTOMS

The features of dengue fever are well known to most practitioners with experience in the northern and north-eastern parts of Australia, particularly in the coastal zones. One feature, common to this group, as already pointed out, is not sufficiently recognised, that the clinical picture is variable, and even striking signs and symptoms in one outbreak may be inconspicuous in another. To regard a "saddle-back" temperature graph as an essential, or severe joint pains, or a rash of a particular type, is to confuse diagnosis. Notwithstanding this qualification the broad outlines are characteristic. As dengue fever was seen in the Services it was an illness

of sudden onset, with considerable early malaise and pains in the limbs, quickly producing prostration which was often severe. Restlessness at night, apparently related to pains in the muscles and their tendinous attachments, contrasted with a dull and drowsy state by day. Puffiness and redness of the face were less conspicuous than in sandfly fever. Splenic enlargement was rare, but the lymph glands were often swollen. Congestion and tenderness of the eyes and pain on moving them were common. Disorders of taste also occurred. Nausea and vomiting and also diarrhoea were occasionally evident during the early florid period of illness. Abdominal discomfort was a feature of some epidemics, for instance in many of a series of over 400 cases seen in one of the Borneo operations.

The usual rashes were observed in a considerable proportion of cases. The preliminary rash usually appeared early and was commonly erythematous, and less often morbilliform. More characteristic were the later rashes, which were often, though not necessarily, seen in connection with a secondary rise in temperature. They were usually macular or maculo-papular. Petechiae were not uncommonly seen especially in severer infections, and chiefly on the extremities. Desquamation frequently followed the fading of the rash. Pruritus occurred in a considerable number of patients. The lace-like patterning of normal white skin described between the fading areas of the rash was often well seen. As a rule no palatal eruption was seen, but it has been recorded. Mild congestion of the mouth and throat were usual, but catarrhal symptoms were as a rule absent. Joint swellings were only very occasionally seen. A mild leucopenia was sometimes found, with an associated decrease of the granular white cells in the blood. The temperature was either of the single or double phase type, the latter causing the so-called "saddle-back" chart. The period of fever was not uncommonly three days, but this was often exceeded. Bradycardia was a well marked feature.

Residual aching in the limbs was sometimes troublesome and an aftermath of mental depression and lassitude prolonged the convalescence of some men. No really important sequels were observed. In some epidemics asthenia of both physical and mental types was common and delayed complete recovery. This was possibly most conspicuous in the considerable epidemics of dengue fever which occurred in the Northern Territory in 1941 and 1942, but in these there were other psychological factors, which exaggerated the effect of isolation both from home and from the forward areas.

No substantial evidence was found of the existence of a neurotropic strain of dengue. Affections of the nervous system during attacks of dengue fever have been observed, usually of the nature of encephalitis. The causal relation does not seem to have been positively established, but the occasional involvement of the central nervous system is more probably due to one of the many variants to which the disease is subject than to a well-defined neurotropic strain. In a medical unit receiving prisoners of war after their release in Malaya, two patients were admitted with dengue fever in which there were some of the less usual features, such as palatal

vesicles and temperature of low range but biphasic type. One man was in a state of violent delirium from which he recovered after a drowsy period, and was readmitted in a state of acute mania. The cerebro-spinal fluid was not under increased pressure. The blood showed 14,000 white cells, 85 per cent polymorphs per cubic millimetre. He recovered rapidly with the absence of one abdominal reflex as the only other abnormal sign. In other respects the clinical picture was thought to be that of dengue, with a macular rash, enlarged glands, painful eyes and congested pharynx.

Investigation of a small series of patients with signs of neck stiffness due to dengue showed that in a few an increase of the cerebro-spinal fluid pressure occurred; in a very few it rose to 200 or 300 millimetres of cerebro-spinal fluid. The protein was on occasion also slightly increased; in one instance to 90, and in another to 200 milligrammes *per centum*. In the latter the cells numbered 23 per cubic millimetre, but had fallen a week later to 10. Increase of cells was only an occasional finding, and then the increase was usually slight.

Immunity was usually conferred by an attack, but this was sometimes only partial. In the naval quarters at Townsville in 1944 a number of men were readmitted within a few weeks with a second attack in which the pattern of fever and symptoms was somewhat different from the first attacks. Two categories of illness were recognised in this outbreak, one with high fever, the other practically afebrile. Ross, in observation of dengue fever at Fanning Island, has studied these practically afebrile attacks, which are found also in the experimentally produced disease. By feeding *Aedes aegypti* on a patient in the first day of illness and allowing the mosquitoes to bite a volunteer he produced an almost afebrile attack. This volunteer had a history of two previous attacks, and Ross has suggested that the afebrile type may represent the reaction of a partly immune person.

DIAGNOSIS

The close resemblances between the signs and symptoms of sandfly and dengue fevers are obvious. The difficulty of diagnosis of both is sometimes considerable at the start of an epidemic or in isolated cases, but the careful observation of both diseases by service medical officers has shown that thorough examination and observation of patients will reveal a fairly characteristic picture in each case if individual symptoms are not regarded as criteria. In the Northern Territory at one time heavy maculopapular rashes suggested measles, but the general clinical pattern was of course quite different. No ordinary pathological tests can do more than give some confirmation of the diagnosis. In malarial areas dengue often posed difficult problems of diagnosis. This could be seen in areas such as Milne Bay after the repulse of the Japanese landing. The amount of malaria that was beginning to sweep the area was not realised at first in all quarters, and the difficulties of demonstration of malarial parasites in men taking suppressive drugs helped to confuse the diagnosis. Comparison of diagnostic figures in Milne Bay showed that their accuracy depended largely on the experience and competency of various services to diagnose

malaria. Pathological resources were then slender in Milne Bay, but the special training of numbers of Australian medical officers and technicians in the microscopic demonstration of malarial parasites in thick films was of great assistance.

EPIDEMIOLOGY

The epidemiology of dengue has always been of interest in Australia, and during this war some fresh aspects appeared. The Commonwealth Health Department's publication on dengue fever pointed out that the distribution of the disease depends on the distribution of the mosquito host, climatic conditions and the existence of herd immunity. In Australia it is only in the endemic areas of the north that the virus can develop consistently in the mosquito, since the temperature there does not consistently fall below the critical temperature of 64° F. In Darwin, the endemic area of greatest importance, the incidence of dengue rises from September to March and falls in the dry season from April to August. Dengue was rife among all Services in the Darwin area. At the end of 1939 the number of non-immunes there was estimated at 2,000. The Director-General of Health sent an entomologist there from the School of Public Health and Tropical Medicine in Sydney, and vigorous anti-mosquito work was undertaken. Among the troops there in 1942 the incidence reached 10 per 1,000 per week. This incidence was surpassed when the disease spread along the air routes to the coast, which is its usual method of extension.

At Townsville a rate of 25 per 1,000 per week was reached, in other words 1,300 per 1,000 per year. Here the problem of control was more difficult than in Darwin, where there was unified control, and less admixture of servicemen and servicewomen and civilians. The known carrier in Australia (*Aedes aegypti*), being domestic of habit, and breeding chiefly in careless accumulations of water about habitations, could be effectively controlled with sufficient effort. Experiences in the past have shown how difficult such control is in civil communities. Regular inhabitants acquire immunity and remain careless. Even in service installations good discipline and considerable effort are required to reduce mosquito populations. In 1940 an epidemic of dengue fever affected 80 per cent of the troops in Port Moresby area, military and civil authorities each blaming the other.

The epidemic in Townsville had some interesting features. Spreading via Cloncurry, Longreach and Charters Towers it first reached Townsville in September 1941 as a sporadic outbreak. By November the civil population was heavily attacked, and next month the R.A.A.F.; army units felt the impact fully by February 1942. Cooperation was obtained between civil and service organisations with beneficial results. In Darwin great efforts were made to remove the abundant potential breeding places, and arrangements were made for spraying of planes leaving the local airfields, and for the disposal of rubbish. Thursday Island and the other islands north of Cape York were heavily affected with dengue also. If the Darwin areas in particular could be controlled the chief endemic centres would cease to feed the yearly flow of the disease southward, where it regularly attacks Queensland and the north of New South Wales.

The distribution of *Aedes aegypti* was known to be wide, even to the central part of New South Wales. McCulloch carried out entomological surveys which showed that this mosquito was more widely spread and more resistant to adverse environment than had been thought. Efforts were made in 1942 to suppress mosquito breeding as far as possible, as troop concentrations and movements were increasing on the Australian mainland with the more tense military situation. A regulation was made early in 1943 under the *National Security Act* to enforce notification of dengue fever by all medical practitioners. Information as to the incidence of the disease was regularly furnished by the Chief Health Officer of each State to the military authorities. In Western Australia also there was little doubt that the dengue vector and the disease were seasonally present over wider areas than had been believed. Doubt had been expressed whether it occurred south of Geraldton, but outbreaks of short febrile illness, especially of the house epidemic nature, left little uncertainty about their nature. A survey of Western Australia by army entomologists showed the advisability of mosquito control in Geraldton, which was likely to be a centre of troop movements.

Before the New Guinea campaigns had begun, and for some time after, study of dengue fever in the north of Australia afforded ample opportunity of seeing how a mosquito-borne disease might swiftly flare into a large epidemic. Group Captain Baldwin pointed out that it was possible for half or even three-quarters of a body of men to be attacked with such incredible speed as to arrest military operation for several weeks. Even in some of the island areas where the disease occurred extensively, it was not a pre-existing infection (that is, of "jungle" type, with an animal carrier) but was brought in from other endemic areas by the men themselves.

The Japanese realised also its inroads on manpower, and from intelligence reports it was learned that they claimed to have produced a method of conferring immunity by diluted doses of serum from patients in the florid stages of the disease. No evidence of the use of such a method was found in the islands.

STUDIES ON VECTORS

The question of the insect vector was all-important. Studies of epidemics indicated that there were probably vectors other than *Aedes aegypti* and *albopictus*. The latter was not a prominent vector in most of the areas where Australians served, but in Labuan and Tarakan where considerable dengue fever occurred it was important. In Tarakan a fever of doubtful aetiology was encountered. It was thought to resemble sandfly fever more than dengue fever, chiefly on account of the absence of rash. There were no sandflies and *albopictus* was plentiful; it seems certain that this was dengue fever. During the first New Guinea campaign in 1942-1943 extensive epidemics of a disease believed to be dengue fever occurred, but in areas where no *Aedes aegypti* could be found. Accordingly an investigation was undertaken by the Australian Army Medical Services. A number of species of *Aedes* mosquitoes were collected at Port Moresby, fed on

volunteers in the early stages of dengue fever and flown to Sydney. The species selected were abundant at Moresby and Milne Bay: *A. funereus* Var. *ornatus*, *similis*, and *vigilax*, and *Mansonia uniformis*. They were allowed to bite healthy volunteers in Sydney who had not been exposed to dengue fever, but these attempts in transmission were unsuccessful. Later, when Lae and Finschhafen were taken, extensive epidemics of a disease confidently diagnosed as dengue fever occurred in these bases and also in the Ramu Valley. *Aedes scutellaris* was observed to be prevalent there, particularly in the localities where dengue occurred. Mosquitoes of this and other suspect species, such as *armigeres*, were grown from larvae, fed on donors selected as suffering from dengue, and flown under high priority to Sydney. This time transmission experiments at the 113th General Hospital, Concord, were successful. Volunteers on whom the mosquitoes were fed contracted illnesses clinically recognised as dengue fever, and by intravenous inoculation of their blood into other volunteers, and further sub-inoculation from the latter, the second and third generations of the infection were produced. The experimentally produced disease was characterised by prodromal headache and backache for several days, a rapid onset, pain in and suffusion of the eyes, redness of the palate, a macular rash on the trunk, and one-phase and two-phase types of temperature. Bradycardia was common. Sub-inoculation was successful on the third or fourth day. Re-inoculation of the original volunteers failed to produce the disease, thereby establishing the presence of immunity. As none of the volunteers had ever been in a dengue zone, the proof was definite that *A. scutellaris* could act as a vector of dengue. This explained the occurrence of dengue over a wide area in New Guinea: it seemed possible that there might even be other vector mosquitoes. This work, carried out under Lieut-Colonel Mackerras, Director of Entomology, illustrated how essential it is to have exact knowledge of all factors concerned in the propagation of insect-borne disease. It is of interest that Ross, whose observations on dengue on Fanning Island have been referred to above, has noted the presence of *A. scutellaris* there.

PREVENTION

Control of *A. scutellaris* was not as simple as of *Aedes aegypti* which has more domestic habits and can be dealt with by abolishing casual water about dwellings. Dengue control being largely a question of mosquito control was dependent on study of the habits of mosquitoes, and these varied considerably in different areas. In settled areas tins were the main breeding places of *scutellaris*; in many localities coconut shells were of the greatest importance, and in the Ramu Valley the axils of banana and taro leaves were favoured by the vectors. As the *Aedes* is a day biter, protective clothing and repellent lotion were also important. In the North-Eastern Area in 1944 it was noticed that proportionately more members of the W.A.A.A.F. had dengue than the men of the R.A.A.F. The suggestion was made that protective clothing should be worn by women, that is slacks and long-sleeved shirts, but control of the breeding of mosquitoes was

considered a much more important factor. In hospitals the use of mosquito nets and spraying of wards were necessary in infested areas. Exact study of the biting habits and flight characteristics of individual mosquito species was important. In the case of *A. scutellaris*, for example, such study showed the hours at which the mosquitoes entered tents or buildings and therefore the most effective hours for spraying. *Scutellaris* bred abundantly at 1,800 feet above sea level, and adults were found at Sattelberg, at 3,200 feet. On the other hand larvae have been found within a few feet of the edge of the sea. Epidemic control was assisted considerably by measures adopted against the adult mosquitoes. Spraying close to the ground near the places where biting was concentrated and denying harbourage to the insects in all possible ways were effective. Broadcast spraying with the potent modern insecticides gave the best promise in the later phases of the island war. It was most important to realise that a heavy vector population in a new area might at first be harmless until the mosquitoes themselves were infected from outside. An army fighting in such areas and based on endemic areas carries these troubles with it. Aircrews can easily introduce infection of fresh areas. Once infected, the *Aedes* can transmit the infection in twelve days, and can do so for the rest of its life of some 280 days. Intelligence concerning the local habits of insect vectors can be of high importance. The study of epidemiology of dengue fever has been of great significance during this war not only for its intrinsic importance, but because it was a small scale model of the much more vital subject of malaria.

3. EPIDEMIC POLYARTHRITIS

During 1941-1942 a febrile illness was observed in the Northern Territory of Australia which was associated with affection of the joints. This was at first thought to be of rheumatic origin. Lieut-Colonel Ingram reported numbers of cases of subacute rheumatism in young soldiers without carditis, and without obvious infective focus. The joints, particularly wrists and knees, were involved in a process which caused pain and crepitus, and which resolved completely.

In the summer of 1942-1943 Halliday and Horan, working in hospitals at Adelaide River and Katherine, noted the prevalence of an acute febrile illness with articular symptoms, and studied over 100 cases. Such epidemics had been reported before, and in 1928 J. R. Nimmo described "an unusual epidemic" at Narrandera, in the south-western area of New South Wales. This took the form of a mild febrile illness with a transient rash, painful swelling of the joints and some tenderness and enlargement of the lymph glands. It was observed in a number of areas in the west of New South Wales during an unusually wet summer. During the previous summer there had been an extension of dengue fever along the inland rivers of this State as far as 32° south, but Nimmo thought this epidemic of 1928 was not dengue, as this disease had not been definitely observed as far south as Narrandera, which is over 34° south. Edwards, however, who saw similar cases, thought they were dengue.

Halliday and Horan have described what appears to be the same disease, and called it "epidemic polyarthritis". Most of the investigations were carried out by Halliday at the 119th A.G.H. at Adelaide River, Northern Territory. A striking feature was the absence of severe constitutional disturbance, and of headache or pain in the eyes. The onset was gradual rather than sudden. Pains in the joints were invariable, and swelling also occurred in the severer forms. Fever was mild and of short duration. The joints of the extremities were most often affected; swelling when present was due either to peri-articular thickening or to effusion or to both. These signs subsided within a week, leaving some degree of stiffness which passed off in two or three weeks' time; occasionally this lasted longer. Tender swellings of the lymph glands occurred. There was occasionally an evanescent maculo-papular rash in the first few days, and in a few instances petechiae were seen; there was never any desquamation. Bradycardia was not observed. Investigations of the blood, urine and all systems failed to reveal any organismal cause. Halliday and Horan did not think this was dengue fever on account of the different clinical picture with its predominantly articular pattern, which did not resemble the dengue fever seen in the area. They noted too that most cases came from areas where dengue was not prevalent and where *Aedes aegypti* was not found. No sequels were observed, though the glandular enlargements cleared slowly.

Towards the end of the epidemic Professor E. Weston Hurst, of the Institute of Medical and Veterinary Science of Adelaide, visited the area, and collected material for bacteriological examination, but inoculation into animals and developing hens' eggs failed to disclose any infective agent.

Many patients suffering from this condition were seen in various parts of the Northern Territory, including men from the Royal Australian Navy, Royal Australian Air Force and the United States Army at Larrimah and Adelaide River. A few cases were seen in September 1942 and possibly earlier; the peak was reached in December and January. There was then some spread of the epidemic towards Western Queensland; probably patients were also seen at Alice Springs. No heavy incidence was observed in circumscribed areas, and there was no evidence of infection by contact, though as high as 14 per cent incidence was found in some units.

In succeeding years outbreaks of an apparently identical condition were described by several observers. In Townsville and Innisfail, on the Atherton Tableland and other parts of Queensland it was recognised. Sibree, in a study of a series, thought it distinct from dengue. Dowling pointed out that outbreaks had occurred in at least three wet seasons in Northern Australia. Goswell observed over fifty patients in an Australian air force station in the Adelaide River-Katherine area. He found the exanthem of a constant type but, while noting the absence of constitutional signs, pointed out a wide variation in severity of the joint affection. Other slight variations in symptoms were observed in different parts of Australia, such as the occurrence of headache as a prominent feature, and slowness in recovery of stiffness of joints. Short in an outbreak in Queensland noted

the prevalence of March flies. The same disease has been recognised also in the South-West Pacific Area, for example in Bougainville.

No association with insect vectors was observed in any area, though it was remarked that culicine mosquitoes were distributed over the areas affected by the disease. While there are obvious similarities between this condition and the dengue-sandfly group of diseases there seems warrant for regarding it as a distinct entity. It can probably be ascribed to an insect vector, but this has not been proved. It seems to be established that dengue fever and a dengue-like disease, equally benign in its general effect, co-existed during the war years in Northern Australia, thus adding another variant to the growing group of short-term fevers.

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